

Pesticide Formulations

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Pesticides are useful chemicals. Extreme caution and care should be exercised during handling and application.

Read the label carefully. The label is a legal document, and any application not consistent with the label is considered illegal.

A license or permit is required to apply some pesticides. Pesticides are classified as "general use" or "restricted use" chemicals. Restricted use pesticides may be applied only by a licensed applicator or under the supervision of an applicator who has been properly certified and licensed by the Montana Department of Agriculture. It is unlawful to use or buy restricted materials without a current certified applicator's license. Check with your county Extension agent to make sure you are properly certified for the use of a specific pesticide.

Either external or internal contact may result in injury. Eliminate pesticide contact by using protective clothing and safety devices. However, the use of protective clothing and safety devices does

not eliminate the necessity for other precautions.

Follow the label directions exactly. Precautions are listed on the label or in technical information sheets. Avoid splashes, spills, leaks, spray drift or clothing contamination. Do not eat, smoke, drink or chew while using pesticides. Wash hands and face immediately after spraying.

Always clean equipment after every use. Calibrate sprayers at least once or twice a year. Orifice sizes often change due to corrosion and wear

Caution: Follow the label for specific rates and application procedures for any situation. Some of these chemicals are not recommended for domestic application, except by professional applicators.

Pesticides are available in various formulations. The pesticide itself, or the ingredient which actually has the toxic action, is called the active ingredient. A formulation is a combination of the active ingredient and one or more inert ingredients. Inert ingredients usually are added to improve the effectiveness of the active ingredient. These inert ingredients usually determine the method of application.

The most important formulations are dusts, sprays, wettable powders, flowables, emulsifiable concentrates, granules, baits and encapsulated pesticides.

Dusts

Dusts are dry materials that are made by the combination of the active ingredient with an inert material that acts as a diluent or carrier. Dust will usually contain one to five percent active ingredient.

These formulations are most commonly found in insecticides and fungicides. They are not used extensively, because the small size of the particles makes them highly susceptible to drift.



Sprays

Sprays are materials in which the active ingredients are formulated as a liquid solution. The active ingredient often is insoluble in water. In this case an emulsifying additive is needed. The emulsifiers are surface-active agents that promote mixing with water to form a suspension. When an emulsifier is added to the active ingredient it is usually called an emulsifiable concentrate and is represented by the letters "EC." Emulsifiable concentrates probably are the most common formulations used today. Their active ingredient content usually is expressed as a percentage of the total formulation, or as pounds of active ingredient per gallon of formulation. When the active ingredient is soluble in water, it usually is found as a liquid and represented by the letter "L."

Emulsifiable Concentrates

The solvents, in many cases, may tend to injure some crops. Read the label to determine which crops are sensitive. Additionally, emulsifiable concentrates may require some slight agitation to maintain the suspension. Hydraulic agitation usually is enough.

Wettable Powders

If the active ingredient is insoluble in water, it may be formulated as a wettable powder. The active ingredient in a wettable powder is combined with a solid material—usually a clay or talc and suspended in water—with the aid of an emulsifier.

Vigorous and constant agitation is required with wettable powders to maintain a uniform suspension. Mechanical agitation generally is preferred. Many manufacturers now package wettable powders in water-soluble packets that will dissolve in the spray tank.

Crop injury rarely is a problem with wettable powders, due to the lack of organic solvents.

However, wettable powders cause excessive wear on nozzles after prolonged use. Additionally, many wettable powders may leave visible deposits of the diluent on the crop.

Flowables

Flowables are formulated by impregnating the active ingredient on a diluent or carrier, such as clay or talc. These particles then are suspended in a small amount of liquid as a thick, paste-like material. The suspension usually is maintained with little agitation.

Granules

The active ingredient in a granular formulation is combined with many of the same materials used to make dusts. Granules generally are used for soil application where slow release of the chemical is required. Granules also are used to increase the safety margin of some soil-applied materials. Drift problems are essentially eliminated by the use of a granule. Granules generally are large particles, formulated with two to 40 percent active ingredient.

Baits

Baits are formulated in combination with an attractant which lures the pest to the bait and pesticide. Baits are generally used for insecticides, rodenticides and avicides.

Aerosols

Aerosols contain a pesticide dissolved in a liquid and held under pressure. A fine mist is expelled when this mixture is released by a pressure valve on the container. This mist contains fine droplets that remain suspended in the air for considerable time. After the liquid carrier evaporates,

minute pesticide deposits remain. Aerosols are most appropriate for use within buildings, although there are types available for limited outdoor treatment. Insecticidal fogs generated by heating a mixture of an insecticide in a solvent such as kerosene utilize a similar principle. The fogs are used outdoors to control certain flying insects such as mosquitoes and flies. Aerosols seldom are used commercially for foliar application because of drift problems.

Fumigants

Fumigants are volatile pesticides that kill pests with vapors. Fumigants can be used only where the gas can be confined, such as in storage bins, in the soil, within buildings or under gas-tight tarps. Fumigants are effective against nematodes, weeds, fungi and insects. Some are formulated only as gasses, but others are volatile liquids.

Ultra-Low-Volume Concentrate

Ultra-low-volume pesticides are concentrated liquids to be used undiluted. Both aircraft and ground equipment may be used to apply ULV sprays. Special nozzles such as spinning disks or spinning cages usually are required for application. The content of an active pesticide in an ultra-low-volume concentrate is stated as the percentage, by weight, in the formulation.

Encapsulated Pesticides

Encapsulated formulations are relatively new. The active ingredient is encapsulated by a synthetic polymer to allow for prolonged release of the pesticide over a period of time. Encapsulation provides a slow release mechanism and usually is more expensive than other formulations. However, the long-term benefit often makes this formulation feasible.

Adjuvants

An adjuvant is a substance that is added to a material to increase the efficiency of the main ingredient.

- *Surfactant.* A surfactant is a surface active agent. Its primary function is that of a wetting agent. These materials are used to increase the uptake of chemicals.

- *Sticking Agents.* Adhesive or sticking agents increase the adherence of a chemical to a surface.

- *Dispersing Agents.* These substances reduce the cohesion between particles that are alike. Some wetting agents and dispersing agents are not compatible and have a tendency to interfere with each other if used together.

Phytotoxicity

Phytotoxicity means plant injury. There are numerous reasons why a pesticide may cause plant injury. However, all pesticides used according to the label should present little or no damage.

Conditions that may cause a toxic response to plants include excessive dosages, climatic conditions, plant stress, chemical incompatibilities, drift onto non-target plants, improper timing and improper application techniques.

Problems such as these should never arise if the directions and precautions listed on the label are strictly followed. Most chemical formulations are designed to perform under the greatest possible number of different conditions and to give satisfactory results.

Physical Incompatibilities

Physical incompatibilities usually show up as a precipitation in the spray solution. The precipitated products usually are in the form of crystalline solids or gelatinous masses. Both may cause plugging of screens or nozzles as

well as induce plant injury.

Another form of physical incompatibility is separation of components. This normally will happen when the materials are extremely different in their chemical makeup, or where agitation is inadequate.

Chemical Incompatibilities.

Chemical incompatibility occurs when the material breaks down into compounds other than those of the original pesticide, or when the products chemically combine with each other to produce another compound. Chemical incompatibility involves deactivation of the products and may result in complete or partial failure.

Incompatibilities may show up as increased toxicity of the spray solution. Care must be taken when combining chemicals. The addition of too much emulsifying additive can cause a decrease in the effectiveness of the spray solution. In this situation, the emulsion containing the active ingredient will run off the plant. Many emulsifiers may cause phytotoxicity by dissolving the waxy coating on the leaves. Overdosing, or the addition of surfactants that are not compatible with the pesticide, may result in excess residues. There is a limit to the amount of residue that can be in or on the plant material. Therefore, it becomes a legal problem, as well as an incompatibility problem.

Materials containing lime, or having a high alkalinity, may be incompatible with synthetic organic chemicals. Most of the organic phosphates and carbamates are subject to varying degrees of decomposition in alkaline solutions. Many of the chlorinated hydrocarbons and dinitro compounds are also affected by high

alkaline solutions. Care must be exercised when combining many of the organic chemicals with oils or petroleum solvents.

Incompatibility problems usually result in foliage injury. Most of the carbamates, many of the organic phosphates and most of the dinitro miticides may result in this kind of injury. Foliage burning also may occur when dinitros are combined with organic phosphates.

Never combine wettable powders with emulsifiable concentrates. It also is unwise to combine emulsifiable concentrates with a salt solution. Both of these combinations generally will disrupt the emulsifiable system, causing the material to settle out of the tank. Always combine two different agricultural chemicals in a diluted state. Never combine two or more concentrates together.

Legally, the combination of two or more pesticides requires registration. A material may not be used in any manner that is not consistent with the label. Therefore, a combination that has not been tried and proved, and officially registered, is illegal.

Check with the Montana Agricultural Experiment Station, MSU Extension Service or companies that manufacture the product if there are questions concerning compatibility. It is always a good procedure to first check compatibility by mixing chemicals in small quantities before mixing them in the spray tank. Mix the proper amount of each pesticide with the carrier that will be used in a quart container. Shake the mixture thoroughly and observe the mixture immediately, after about 30 minutes and again after allowing to stand for a few hours.

Combining Pesticides With Fertilizers

Combining pesticides with fertilizers is tricky business. Mixing simple fertilizers such as superphosphates, phosphoric acids and nitrogen may present no real incompatibility problem. However, there are many exceptions. Liquid fertilizer mixes may present a highly complex problem. There may be many impurities in liquid formulations that may differ from manufacturer to manufacturer and from batch to batch. Always follow label directions when mixing pesticides with fertilizers.



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